

Littorina kasatka, a New Species from the Kurile Islands and Okhotsk Sea

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ABSTRACT

A new species, *Littorina (Littorina) kasatka*, is described from the Kurile Islands and Okhotsk Sea. It is similar in shell characters to a smooth form of *L. (Neritrema) sitkana*, with which it is sympatric, but is distinguished by the absence of mammilliform glands on the penis of the male and by the small jelly gland of the female. It is predicted that *L. kasatka* produces pelagic egg capsules and has planktotrophic development.

Key words: *Littorina*; Pacific; Larval development.

INTRODUCTION

The generic name *Littorina* has in the past been applied to many littorinids with relatively large, smooth or spirally sculptured shells, that occur in the littoral zone. However, a recent phylogenetic analysis of the Littorinidae, based largely on anatomical rather than shell characters, has defined *Littorina* more narrowly as a monophyletic clade of about 20 species (Reid, 1989). Species of *Littorina sensu stricto* are found only in the northern hemisphere, where they are characteristic inhabitants of the eulittoral and littoral fringe on temperate and cold temperate shores.

During the past two decades close investigation of the reproductive anatomy of European *Littorina* species has revealed the existence of three additional species, previously unrecognized by shell characters (review by Raffaelli, 1982; Johannesson & Johannesson, 1990). The biochemical technique of enzyme electrophoresis has confirmed that these species are genetically distinct (review by Ward, 1990). More recently, a pair of sibling species has been identified in the northeastern Pacific, again using the dual approach of reproductive anatomy and biochemistry (Murray, 1979; Mastro *et al.*, 1982). In contrast, the *Littorina* of the northern and northwestern Pacific are poorly known. This paper describes a new species that was discovered during a genetic study of *Littorina kurila* Middendorff, 1848 from the Kurile Islands and Vostok Bay (Zaslavskaya & Sergievsky, in press). (*Littorina kurila* is a junior synonym of *L. sitkana* Philippi, 1846, see note added in press in Reid, 1990a). Of 11 loci examined, alleles common to the two species were found at only two, and the genetic identity was conse-

quently low (Nei's (1978) genetic identity $I = 0.065$). The new species was recognized independently during anatomical studies of *Littorina* material from the Zoological Institute, Leningrad, as part of a systematic study of all *Littorina* species in the Pacific (Reid, in prep.). Recognition of the new species in the field is difficult, since shell form is similar to that of *L. sitkana* and several other *Littorina* species, but both males and females display unique reproductive anatomy.

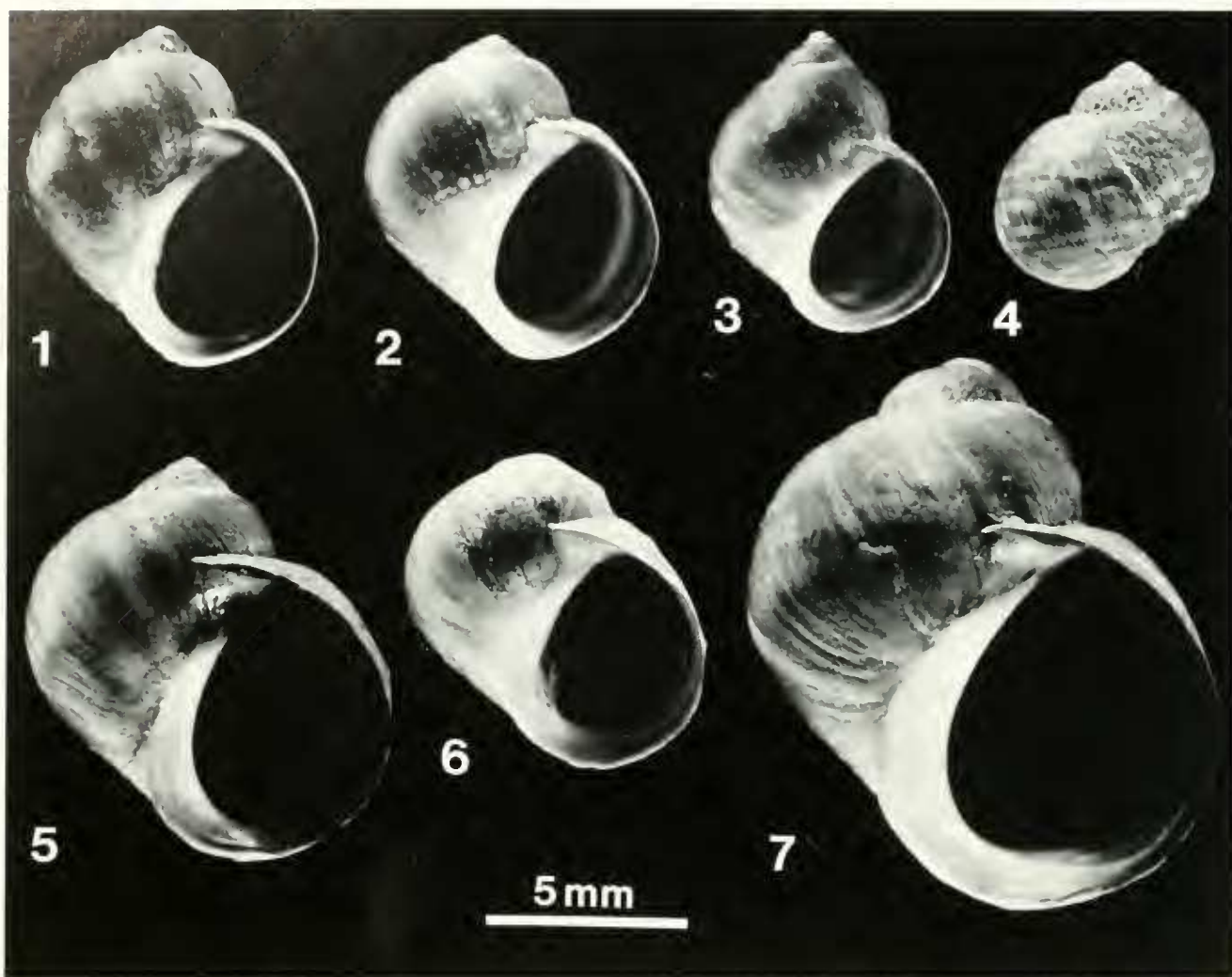
MATERIAL AND METHODS

The new species is described from six lots in the Zoological Institute, Leningrad (ZIL), and one lot in the Zoological Museum, Moscow (ZMM), all of which are duplicated in the Natural History Museum, London (BMNH). That it is indeed undescribed was confirmed by comparison with original descriptions of all available names of *Littorina* species from the Pacific, and with all available type specimens (housed in BMNH, ZIL and National Museum of Natural History, Washington, D.C.); details will appear elsewhere, in a full account of the systematics of *Littorina* (Reid, in prep.). Closely related species are discussed briefly below.

The reproductive anatomy was examined in ten males and nine females. The spiral pattern of the albumen and capsule glands of the pallial oviduct can be seen, without dissection, on the right side of the body adjacent to the columellar muscle, when a female is removed from the shell. Serial histological sections were prepared of the pallial oviduct of two females. Radulae were extracted from six specimens from three localities, and after cleaning in hot concentrated sodium hydroxide solution were examined by scanning electron microscopy. For comparison, 45 specimens of *L. sitkana* were dissected, from localities all around the northern Pacific from Hokkaido to Washington, and four radulae were examined. Details of other *Littorina* species investigated are given in Reid and Golikov (1990).

SYSTEMATIC DESCRIPTION

Littorina (Littorina) kasatka new species
(figures 1-4, 8-11, 12-20, 23)



Figures 1-4. *Littorina kasatka* new species. 1. Holotype (BMNH 1990050), Kasatka Point, Iturup I., Kurile Is. 2. Paratype (BMNH 1990051). 3. Nataliya Bay, Urup I., Kurile Is. 4. Paramushir I., Kurile Is. Figures 5-7. *Littorina sitkana* smooth form, from localities at which it is sympatric with *L. kasatka*. 5, 7. Kasatka Point, Iturup I., Kurile Is. 6. Nataliya Bay, Urup I., Kurile Is. All specimens in BMNH

Types: holotype BMNH 1990050, Kasatka Point, Iturup I., Kurile Is, USSR (figure 1); 9 dry paratypes BMNH 1990051; 38 paratypes in alcohol BMNH 1990052; 10 paratypes in alcohol ZIL.

Etymology: named after type locality.

Shell (figures 1-4): **Dimensions:** Adult size range 6.4-11.0 mm shell height.

Shape: Telococonch approximately 4 whorls (apices eroded in available specimens), moderately solid. Globular to turbinate, whorls smoothly rounded, sutures distinct. Columella rather narrow, slightly excavated, pillar concave; sometimes a slight chink between edge of inner lip and base of body whorl (not a true umbilicus).

Sculpture: Indistinct axial growth lines only, no spiral grooves; faint spiral striae sometimes visible at high magnification.

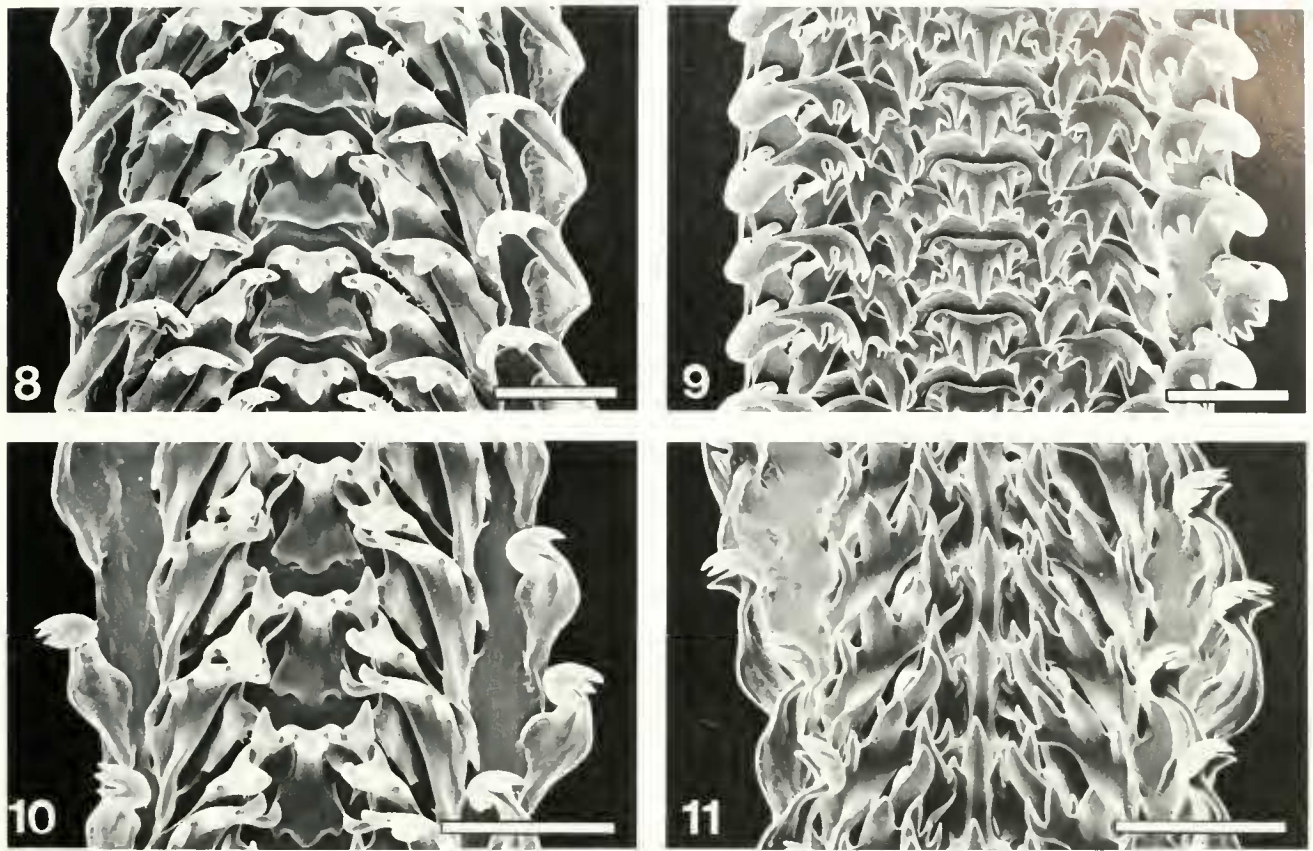
Color: Mid-brown, often with 6-16 rows of smudged whitish dashes, especially at periphery and on base, occasionally forming tessellated pattern (figure 4). Aperture purplish brown. Columella white to pinkish brown.

Animal: Head-foot (figures 19, 20): Head black, pale tips to tentacles and snout, unpigmented stripe across tentacle base and eye, or unpigmented patch at inside of tentacle base only. Sides of foot grey to blackish.

Operculum: Normal, paucispiral littorinid (type A of Bandel & Kadolsky, 1982).

Penis (figures 14-18): Wrinkled base lacking mammiliform glands; small, blunt filament not clearly demarcated from base; sperm groove open to tip.

Pallial oviduct (figures 12, 13): Complex spiral of 3 loops of albumen and capsule glands; final straight section



Figures 8–11. Radulae of *Littorina kasatka* new species. Scale bars = 50 μ m. 8, 9. Kasatka Point, Iturup I., Kurile Is. 10, 11. Paramushir I., Kurile Is. 8, 10. Viewed flat. 9, 11. Same radulae as Figures 8, 10, but viewed from angle of 45° to show cusp shape.

(containing jelly gland) short, not swollen or septate. Bursa copulatrix small, opening in anterior position.

Radula (figures 8–11): All cusps moderately pointed. Rachidian with 3 large, 2 small cusps; outline of tooth (viewed flat from above) varies from square to oblong (ratio of length of tooth : width at mid-point 1.00–1.78). Lateral and inner marginal each 4 large cusps. Outer marginal 6–8 cusps.

Distribution: *Habitat:* Rocks and boulders in middle and upper littoral zone of sheltered shores.

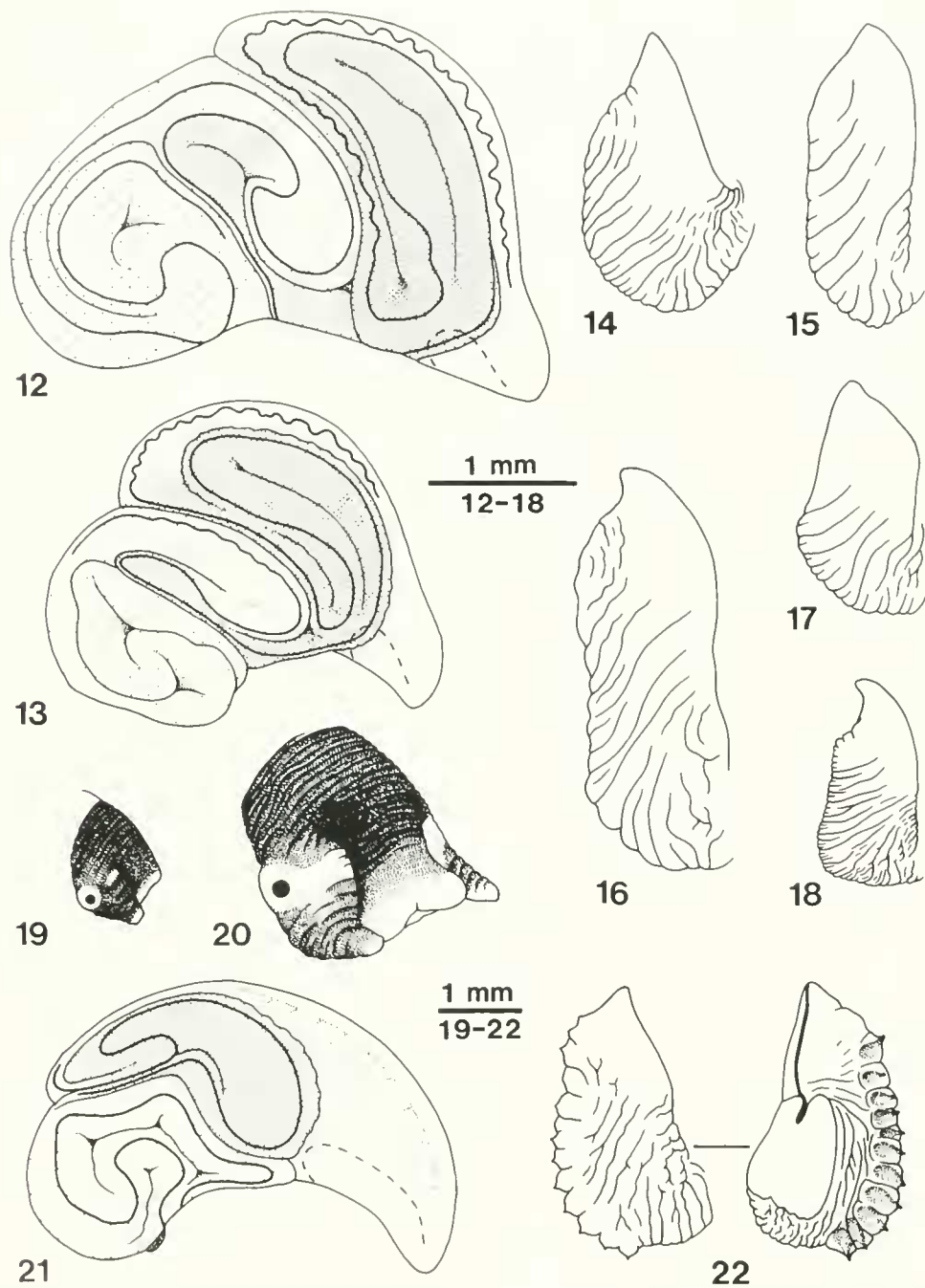
Range (figure 23): Kurile Islands, Gulf of Shelikov in Okhotsk Sea.

Records: Kasatka Bay and Kasatka Point, Iturup I.; Nataliya Bay, Urup I.; Ryponkich I.; Paramushir I. (all ZIL and BMNH); between Nepropusk and River Gank, W. Kamchatka, Gulf of Shelikov (ZMM, BMNH).

Similar species: Four *Littorina* species are geographically sympatric with *L. kasatka* over its known range: *L. (Littorina) squalida* Broderip & Sowerby, 1829; *L. (Neritrema) sitkana*; *L. (N.) subrotundata* (Carpenter, 1864) and a newly described species (Reid & Golikov, 1990). Of these, no confusion will arise with *L. squalida*, which is a much larger (12–44 mm), spirally-grooved

shell (figured by Reid, 1990a). *Littorina subrotundata* and the newly described species are also usually larger (4–14 mm and 6–16 mm respectively), both are a more patulous shape, and both have a color pattern of dark brown spiral lines on a paler brown ground (figured by Reid & Golikov, 1990). Anatomically, these two species both show mammilliform penial glands in the male and a large, swollen, septate jelly gland in the female, unlike *L. kasatka*.

Littorina sitkana is the most similar to *L. kasatka* and is apparently found in the same habitat, since all but one of the seven known collections of *L. kasatka* were separated from mixed lots of the two species. *Littorina sitkana* is highly variable. The form that occurs most commonly in the northeastern Pacific has strong spiral ribs with striae in the grooves between, but in the northwestern Pacific (and especially in the Kurile Islands and Okhotsk Sea) the common form is smooth shelled. This smooth form has been referred to as *L. kurila* (this name is actually a synonym of *L. sitkana*, see Reid, 1990a) in all recent Soviet literature (e.g., Golikov & Kusakin, 1978). Since *L. kasatka* lacks spiral ribs and obvious striations, it is easily distinguished from sculptured shells of *L. sitkana* (figured by Reid, 1990a). However, smooth forms of *L. sitkana* are extremely similar. *Littorina sitkana* is usually larger (commonly 15 mm, up to 23 mm), has a



Figures 12-20. *Littorina kasatka* new species. 12, 13. Pallial oviducts. 14-18. Penes. 19, 20. Heads. 12, 17. Nataliya Bay, Urup I. 13-15, 20. Kasatka Point, Iturup I. 16. Kasatka Bay, Iturup I. 18, 19. Paramushir I. Figures 21, 22. *Littorina sitkana*, Seldovia, Alaska. 21. Pallial oviduct. 22. Two views of penis; mammilliform glands shaded. All specimens in BMNH. Key to figures 12, 13, 21: sparse stipple, albumen gland; dense stipple, capsule gland; dotted lines, septa of jelly gland (visible by transparency); dashed lines, bursa copulatrix (visible only by dissection or serial sectioning).

slightly more inflated last whorl, and the columella is relatively wider (figures 5-7). Coloration also differs, *L. sitkana* being purple brown or blackish, sometimes with one or two white or orange spiral bands, and never showing the flecked or tessellated pattern of *L. kasatka*. The only entirely reliable means of distinguishing the two species is by their reproductive anatomy: in females, the

pallial oviduct of *L. sitkana* has two loops in the spiral pattern, and a large, swollen, septate jelly gland (figure 21), whereas there are three loops and a small jelly gland in *L. kasatka*; in males, mammilliform penial glands are present in *L. sitkana* (figure 22), but absent in *L. kasatka*.

Shells of the new species do not resemble closely those of any other *Littorina* from the northeastern Pacific or

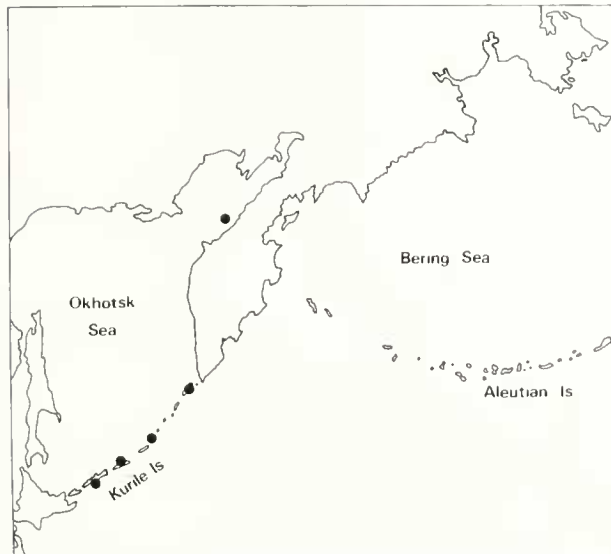


Figure 23. Distribution of *Littorina kasatka* new species. Record from Gulf of Shelikoff could not be precisely localized.

Atlantic. No other *Littorina* has a pallial oviduct of the same form (Reid, 1990a), and only in *L. scutulata* Gould, 1849 and *L. striata* King and Broderip, 1832 does the penis also lack mammilliform glands.

DISCUSSION

The diversity of types of spawn and development within the genus *Littorina* have been reviewed by Reid (1989, 1990a), who showed that the type of spawn can be predicted from the relative sizes of the glandular components of the pallial oviduct. From its small jelly gland, lack of brood pouch and presence of a large capsule gland, it is likely that *L. kasatka* produces pelagic egg capsules. In other *Littorina* species that occur at high latitudes and reproduce in this way, the capsules are large (about 1 mm in diameter), biconvex and contain several eggs, and the capsules of *L. kasatka* are probably similar. It has been suggested that large capsules of this type are adaptive in relation to high levels of predation on pelagic propagules in cold seas (Reid, 1990a). The only other Pacific *Littorina* with pelagic capsules that occurs at such a high latitude is *L. squalida*. All known littorinids with pelagic capsules show planktotrophic development, so this can be predicted in *L. kasatka*. In contrast, the other four *Littorina* species in the northern Pacific are non-planktotrophic, developing within benthic gelatinous egg masses (Reid & Golikov, 1990).

A cladistic analysis of the 20 or so species of *Littorina* then known was given by Reid (1990a), and used as a basis for subgeneric classification. With three loops in the spiral of the pallial oviduct, a small jelly gland and probable pelagic egg capsules, *L. kasatka* is clearly a member of the paraphyletic subgenus *Littorina*. Within that area, its relationships cannot yet be resolved by cladistic analysis, because of uncertainty about its spawn.

The presence of a bursa copulatrix in an anterior position does, however, suggest that its most likely place on the cladogram is between nodes 9 and 10 (see figure 5 in Reid, 1990a). As a result of the cladistic analysis the subgenus *Neritrema* was defined by the synapomorphies of anterior bursa copulatrix, large jelly gland and non-planktotrophic development (Reid, 1990a). In view of the anterior bursa of *L. kasatka*, this character must now be removed from the list of synapomorphies of *Neritrema*. The cladogram has also been used for a biogeographical analysis, which showed that in general the more derived species of northwestern Pacific *Littorina* occur at higher latitudes (Reid, 1990b). The probable position in the cladogram and known geographical distribution of *L. kasatka* are consistent with this trend.

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